

January 1996

Preliminary Data Summary

by Field Research Facility

U.S. Army Corps of Engineers
Waterways Experiment Station
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Contents

Preface	iv
1SQIntroduction	1
2SQMeteorological Data	7
3SQWave Data	12
4SQCurrent Data	17
5SQVisual Observations	20
6SQWater Levels	22
7SQBathymetry	24
8SQSpecial Events	27

List of Figures

<u>No.</u>	
1	FRF Location Map
2	Month at a Glance
3	Instrument Locations at FRF
4	Meteorological Monthly Summary
5	Wave Heights and Periods
6	Water Levels
7	CRAB Profiles
8	CRAB Profile Envelope
9	FRF Bathymetry (10 January 96)

List of Tables

<u>No.</u>	
1	Instrument Status/Data Availability
2	Gauge Locations
3	Meteorological Data
4	Wave Data
5	Current Meter Data
6	Visually Observed Current Data
7	Visual Observations
8	Water Levels

Preface

This report provides a summary of basic oceanographic, meteorological and bottom profile data for the month. The data were obtained as part of the Measurements and Analysis work units at the U.S. Army Engineer Waterways Experiment Station, Coastal Engineering Research Center's Field Research Facility (FRF) in Duck, North Carolina. The FRF staff collected and analyzed these data. These summaries are intended to make the data readily available to all FRF users, and comments on their content and usefulness are invited.

These reports are now available via the World Wide Web at
<http://frf.wes.army.mil/frf.html>

These web pages contain general information about the Field Research Facility and data from 1980 to the present.

Your comments and criticisms are welcome.

Introduction

1

The U.S. Army Engineer Waterways Experiment Station, Coastal Engineering Research Center's (CERC) Field Research Facility (FRF) is located on the Outer Banks of North Carolina, near the village of Duck (Figure 1).

The FRF research program provides a means for obtaining high-quality field data, particularly during storms, in support of the U.S. Army Corps of Engineers' coastal engineering research missions. The research pier is a reinforced concrete structure supported on 0.9-m-diam steel piles spaced 12.2 m apart along the pier's length and 4.6 m apart across the width. The pier deck is 6.1 m wide and extends from behind the duneline to about the 6-m water depth contour at a height of 7.75 m above the National Geodetic Vertical Datum (NGVD) of the year 1929.

One of the responsibilities of the FRF research program is the collection, analysis and dissemination of data on local bathymetric, oceanographic, and meteorological conditions. This summary is intended to provide basic data as soon as possible after they are obtained. Questions and/or comments concerning the data may be directed to Mr. Clifford F. Baron at (919) 261-3511 (baron@duck.wes.army.mil).

Chapter 2 presents the meteorological data; Chapters 3 through 6 present oceanographic data; Chapter 7 presents nearshore profiles and bathymetry; and Chapter 8, if included, documents special events that occurred at the FRF during the month.

Table 1 is a list of instruments used and their operational status during the month. Figure 2 shows weather and ocean conditions for the month. Table 2 and Figure 3 identifies the location of the instruments. The water depths at the wave gauges and current meters vary and may be determined from information contained in Figure 9. Other installation information is contained in Table 1.

Times given in the report are referenced to eastern standard time (EST).

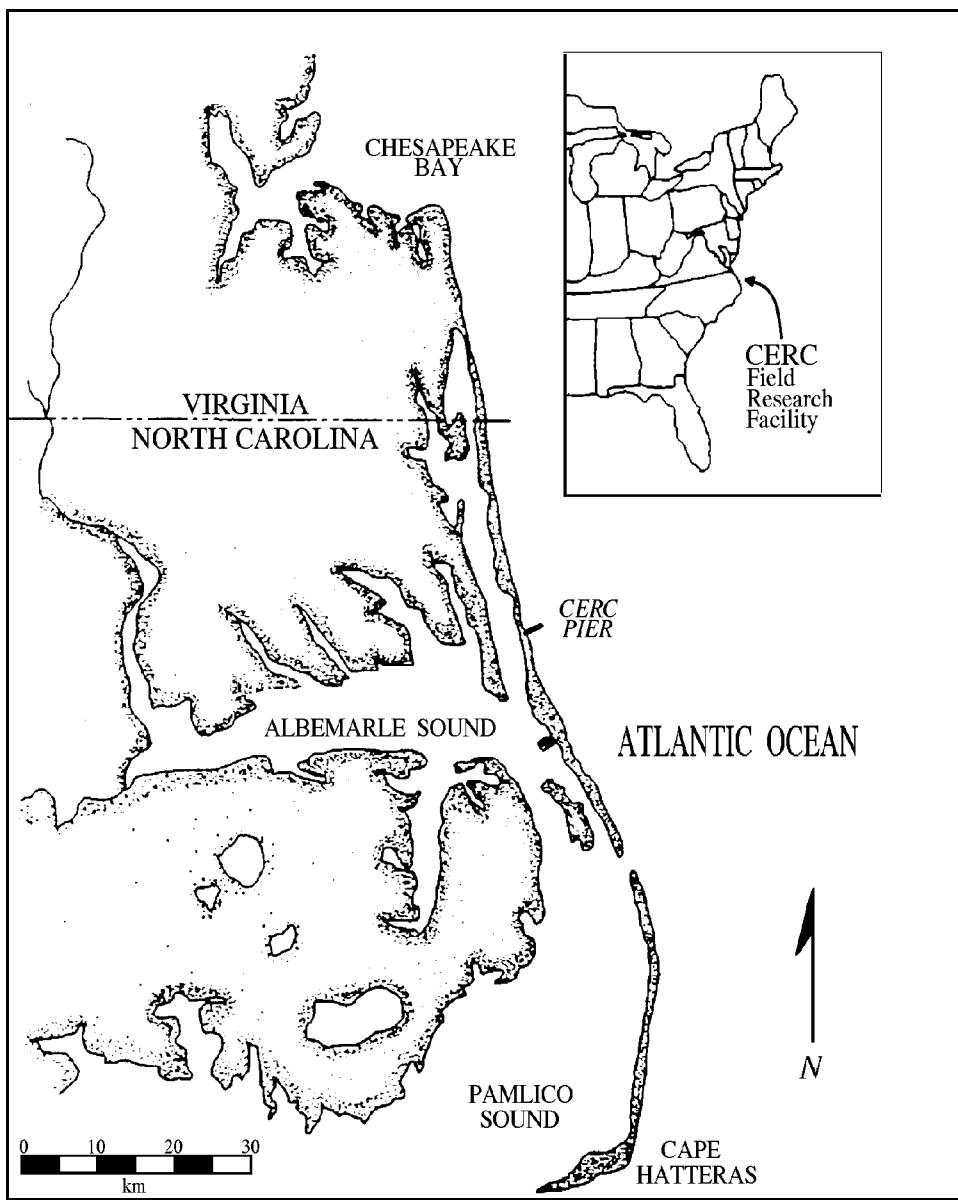


Figure 1. FRF Location Map

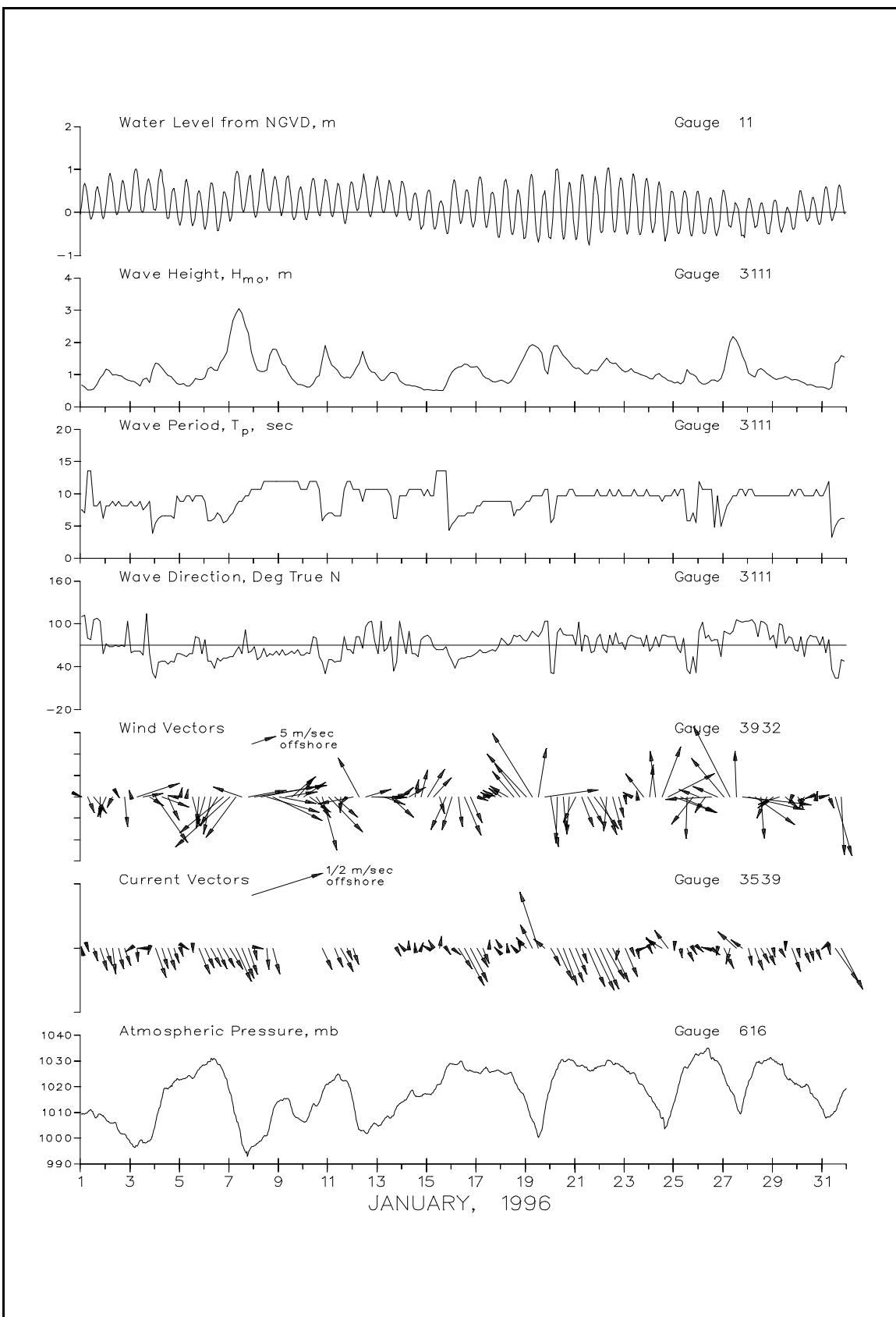


Figure 2. Month at a Glance

Table 1
Instrument Status/Data Availability

		January 1996																																
		Day of the month																																
Gauge ID	Description/Remarks	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1		
616	Atmospheric Pressure	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
	Gauge Status	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
	Data Collected	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
604	Precipitation	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
	Gauge Status	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
	Data Collected	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
624	Air Temperature	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
	Gauge Status	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
	Data Collected	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
3932	Anemometer	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
	Gauge Status	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
	Data Collected	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
641	Pressure Gauge on FRF pier	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
	Gauge Status	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
	Data Collected	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
625	Baylor staff on FRF pier	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
	Gauge Status	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
	Data Collected	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
3111	8 Meter Array 309 m north of FRF	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
	Gauge Status	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
	Data Collected	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
111	Pressure Gauge center of 8 Meter Array	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
	Gauge Status	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
	Data Collected	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
630	Waverider buoy 4.0 km offshore	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
	Gauge Status	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
	Data Collected	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
3539	Current meter 343 m north of FRF pier (1.6 km offshore)	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
	Gauge Status	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
	Data Collected	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
11	NOAA tide gauge at end of pier	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
	Gauge Status	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
	Data Collected	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Visual Observations (daily oceanographic and meteorological observations)		Daily observation	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Gauge Status * = Operational / = Partial - = Non-Operational																																		
Data Collected * = All / = Partial - = None																																		
Visual Observations * = Complete / = Partial - = None																																		

Table 2
Gauge Locations

Gauge*	Description	* Latitude	* Longitude	* FRF Coordinates	* Gauge Depth	* Water Depth
ID *		* Degrees N	* Degrees W	* CrossshoreT Longshore*	NGVD, m	* NGVD, m
*	*	*	*	*	*	*
*	*	*	*	*	m	m
S))))))0)))))))))))))))))))0)))))))))))))))0)))))))))))))))0)))))))))))))))0)))))))))))0)))))))))))Q						
616 * Atmospheric Pressure*	36 10' 57.03"	* 75 45' 5.50"	* 11.60	* 569.00	* -----	* -----
3932 * Anemometer	* 36 11' 1.23"	* 75 44' 43.07"	* 585.20	* 517.30	* 19.50	* -----
641 * Pressure Gauge	* 36 10' 57.71"	* 75 44' 56.23"	* 239.11	* 516.64	* -1.64	* -1.96
625 * Baylor Staff	* 36 11' 1.04"	* 75 44' 43.72"	* 568.00	* 516.64	* Surface	* -8.36
3111 * 8 Meter Array North	* 36 11' 19.14"	* 75 44' 36.41"	* 915.23	* 990.16	* -7.50	* -7.90
* 8 Meter Array South	* 36 11' 11.28"	* 75 44' 33.28"	* 914.20	* 735.37	* -7.42	* -7.90
* 8 Meter Array East	* 36 11' 13.70"	* 75 44' 32.56"	* 954.51	* 800.58	* -7.62	* -8.13
* 8 Meter Array West	* 36 11' 12.48"	* 75 44' 37.11"	* 834.66	* 800.37	* -6.98	* -7.44
111 * Pressure Gauge in	* 36 11' 14.06"	* 75 44' 34.39"	* 914.43	* 825.52	* -7.76	* -8.08
* center of 8 M Array						
630 * Waverider Buoy	* 36 10' 5.10"	* 75 41' 59.30"	* 3934.96	* -2400.81	* Surface	* -17.00
3539 * Current Meter	* 36 11' 23.57"	* 75 44' 9.12"	* 1605.80	* 907.60	* -11.60	* -11.70
11 * NOAA Tide Gauge	* 36 11' 1.25"	* 75 44' 42.60"	* 596.49	* 514.20	* Surface	* -7.62
R	R	R	R	R	R	R

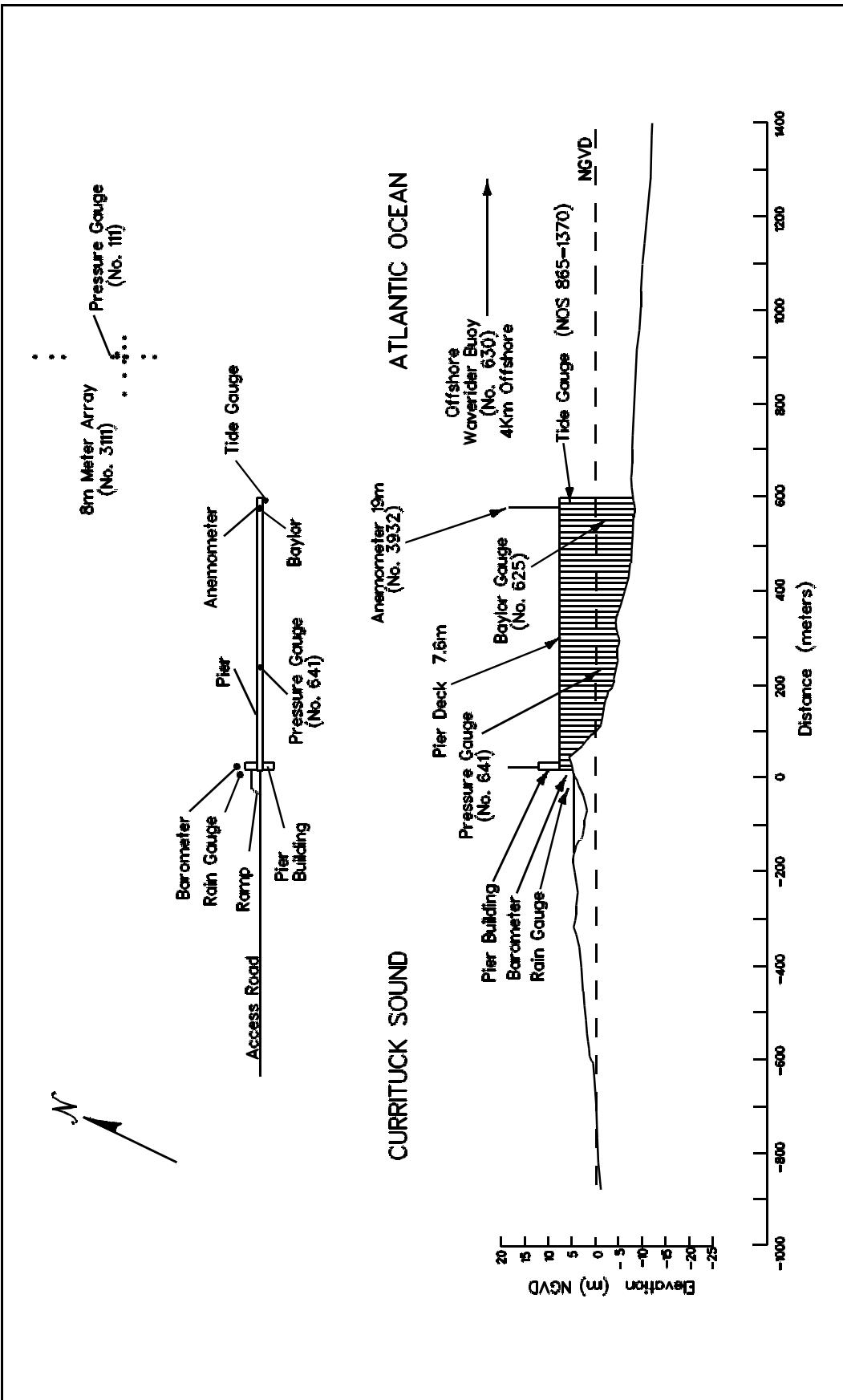


Figure 3. Instrument Locations, Elevations From NGVD

Meteorological Data

2

A variety of instruments have been installed at the FRF (Figure 3) to monitor the meteorological conditions. The data presented in Table 3 are collected and stored using a Digital Equipment Corporation VAXstation 4000. For each instrument identified in Table 1, a log is maintained and the records are stored for future reference.

Winds were measured at the end of the pier at an elevation of 19 m using a WeatherMeasure Skyvane anemometer. Monthly resultant wind speeds and directions (Figure 4) are determined by vector averaging the data. Wind directions (Table 3) indicate where the wind is coming from. Temperature and atmospheric pressure means (Table 3) are the average of the values presented for the month. Total precipitation is the sum for the month.

The following may be useful for converting the data in Table 3 to other frequently used units of measurement:

1. Millimeters (mm) to inches (in.) -
 $mm \times .03937 = in.$
2. Millibars (mb) to inches of mercury (in. Hg) -
 $mb \times 0.02953 = in. Hg$
3. Degrees Celsius (C) to degrees Fahrenheit (F) -
 $(C \times 9/5) + 32 = F$
4. Meters per second (m/s) to knots (kn) -
 $m/s \times 1.943 = kn$

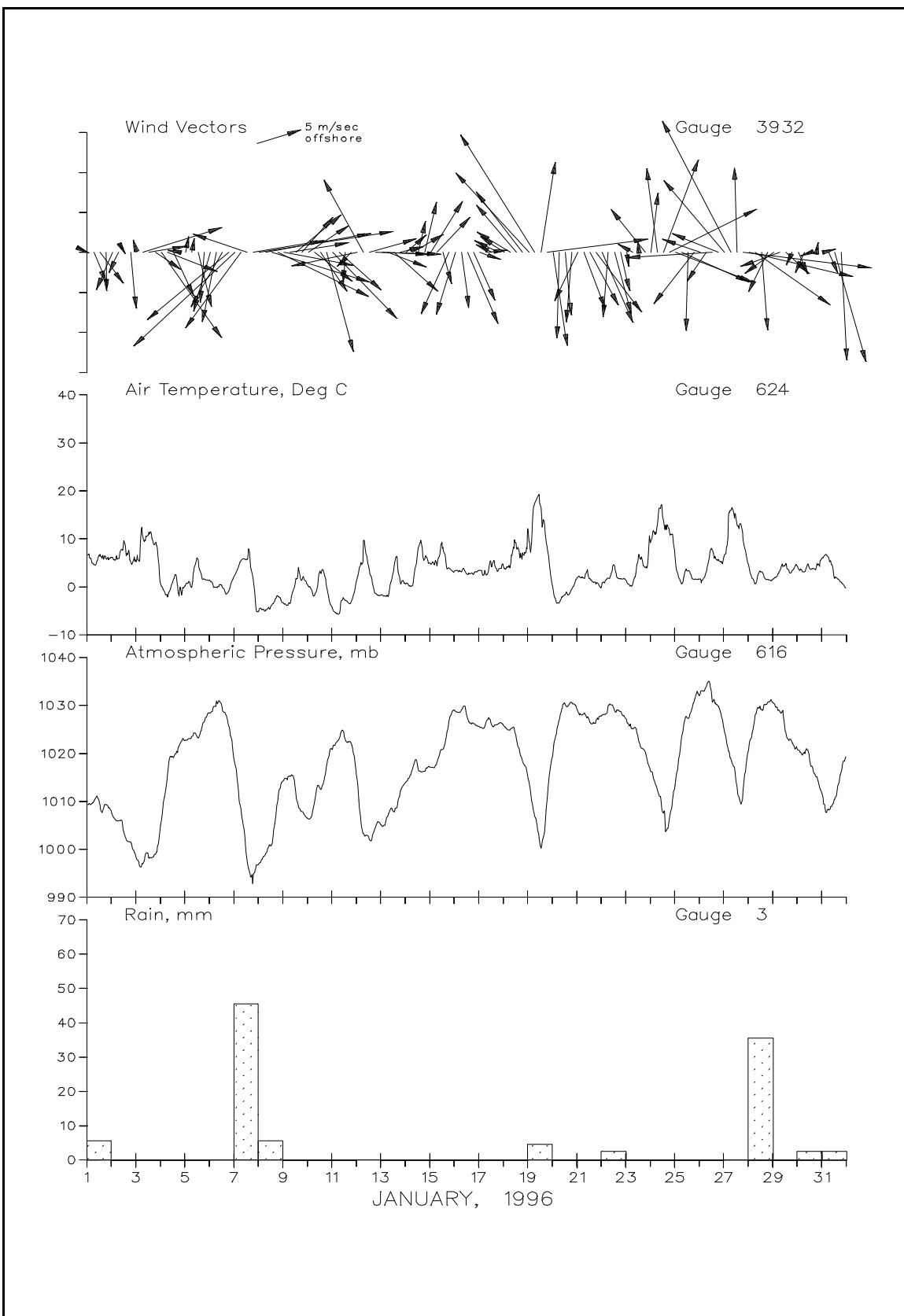


Figure 4. Meteorological Monthly Summary

Table 3
Meteorological Data

Jan 1996						
Day	Hour	Wind Speed m/sec	Wind Direction deg TN	Temperature deg C	Atm Pressure mb	Precipitation mm
1	100	0		6.7	1009.5	0
	700	4	340	4.7	1010.1	5
	1300	5	327	6.8	1009.3	0
	1900	5	359	5.9	1009.3	0
2	100	5	20	6.1	1007.1	0
	700	3	22	5.9	1006.0	0
	1300	0		9.1	1003.0	0
	1900	7	355	5.1	1001.7	0
3	100	2	165	5.7	998.0	0
	700	9	249	10.4	997.1	0
	1300	4	259	11.4	998.1	0
	1900	3	307	9.3	999.1	0
4	100	12	328	0.1	1006.2	0
	700	6	294	-2.2	1015.7	0
	1300	6	338	1.6	1019.2	0
	1900	1	101	-0.7	1021.9	0
5	100	2	189	0.4	1022.8	0
	700	2	188	-0.1	1023.6	0
	1300	7	348	5.7	1023.2	0
	1900	6	3	1.6	1026.7	0
6	100	8	13	1.2	1028.5	0
	700	9	10	-0.1	1030.9	0
	1300	8	26	-0.2	1029.1	0
	1900	12	46	-0.7	1025.7	0
7	100	16	42	2.4	1017.8	0
	700	11	32	5.4	1008.5	46
	1300	6	111	5.8	997.8	0
	1900	8	258	1.8	994.3	0
8	100	15	259	-4.7	997.2	0
	700	12	258	-4.9	999.1	5
	1300	11	289	-3.8	1001.0	0
	1900	11	299	-1.9	1010.1	0
9	100	8	282	-3.5	1014.5	0
	700	6	259	-3.4	1015.4	0
	1300	7	226	1.7	1011.6	0
	1900	5	217	1.4	1007.9	0
10	100	5	232	0.1	1006.4	0
	700	5	311	-1.8	1010.0	0
	1300	6	329	2.9	1012.5	0
	1900	13	346	0.0	1017.6	0

Table 3
Meteorological Data (continued)

Jan 1996						
Day	Hour	Wind Speed m/sec	Wind Direction deg TN	Temperature deg C	Atm Pressure mb	Precipitation mm
11	100	11	320	-4.7	1021.2	0
	700	7	315	-5.6	1023.2	0
	1300	4	2	-2.8	1023.0	0
	1900	2	40	-3.0	1022.1	0
12	100	7	76	2.0	1014.3	0
	700	10	154	9.6	1003.5	0
	1300	5	251	3.4	1002.0	0
	1900	7	271	-1.4	1004.5	0
13	100	5	272	-1.6	1004.8	0
	700	4	293	-2.0	1007.1	0
	1300	7	315	4.2	1007.9	0
	1900	3	253	1.1	1011.9	0
14	100	3	224	0.7	1014.1	0
	700	4	236	0.3	1016.9	0
	1300	4	190	8.1	1016.7	0
	1900	6	191	5.9	1016.4	0
15	100	7	208	4.7	1017.1	0
	700	6	218	4.4	1018.2	0
	1300	4	346	8.2	1021.0	0
	1900	8	21	4.0	1027.0	0
16	100	8	14	3.5	1028.8	0
	700	7	353	3.1	1029.1	0
	1300	9	339	2.6	1027.3	0
	1900	6	339	2.6	1026.2	0
17	100	2	291	3.4	1025.6	0
	700	2	262	2.6	1026.3	0
	1300	2	120	4.1	1026.0	0
	1900	3	120	3.5	1026.1	0
18	100	3	127	3.8	1025.7	0
	700	4	125	4.5	1025.2	0
	1300	7	143	8.1	1023.0	0
	1900	9	146	7.1	1018.4	0
19	100	13	141	9.5	1014.1	0
	700	17	151	17.4	1007.0	5
	1300	11	187	16.4	1000.3	0
	1900	11	261	8.3	1010.6	0
20	100	12	352	-0.7	1020.8	0
	700	11	1	-3.3	1027.0	0
	1300	8	355	-1.6	1030.1	0
	1900	9	3	-0.5	1030.7	0

Table 3
Meteorological Data (concluded)

Jan 1996						
Day	Hour	Wind Speed m/sec	Wind Direction deg TN	Temperature deg C	Atm Pressure mb	Precipitation mm
21	100	6	22	2.1	1028.9	0
	700	7	341	1.9	1028.4	0
	1300	7	335	1.7	1026.5	0
	1900	9	326	0.6	1026.9	0
22	100	9	339	0.7	1028.0	0
	700	8	3	1.8	1029.9	3
	1300	8	346	4.3	1029.0	0
	1900	5	348	1.7	1028.8	0
23	100	2	352	1.1	1026.8	0
	700	2	122	0.7	1025.1	0
	1300	1	174	6.8	1022.5	0
	1900	6	145	4.0	1020.4	0
24	100	7	185	9.6	1016.3	0
	700	11	173	13.1	1012.4	0
	1300	12	197	13.8	1007.6	0
	1900	11	239	11.3	1006.7	0
25	100	9	294	5.0	1014.4	0
	700	8	297	0.5	1023.5	0
	1300	10	1	3.4	1027.4	0
	1900	8	34	1.6	1031.0	0
26	100	4	112	1.7	1032.4	0
	700	4	30	3.1	1033.9	0
	1300	9	85	7.7	1030.7	0
	1900	5	115	5.7	1030.0	0
27	100	11	143	6.7	1024.6	0
	700	18	155	15.9	1018.8	0
	1300	11	178	13.0	1013.2	0
	1900	14	277	9.8	1012.4	0
28	100	12	285	4.0	1021.8	0
	700	10	309	0.6	1028.1	36
	1300	10	356	3.1	1029.2	0
	1900	5	22	1.6	1030.6	0
29	100	4	1	1.7	1030.5	0
	700	5	67	3.3	1028.9	0
	1300	4	316	4.9	1024.4	0
	1900	2	22	3.3	1022.5	0
30	100	3	339	3.7	1020.7	0
	700	3	20	3.2	1020.4	3
	1300	1	67	3.6	1017.6	0
	1900	1	188	4.3	1015.2	0
31	100	1	253	6.1	1011.3	0
	700	3	339	6.1	1008.2	3
	1300	14	346	1.8	1010.5	0
	1900	13	357	1.0	1016.2	0
		Resultant		Mean	Mean	Total
		2	324	3.4	1017.6	106

Wave Data

3

Wave data are collected from three different sets of instruments, as shown in Table 1 and Figure 3. The first is an array of fifteen pressure gauges, collectively referred to as gauge 3111 (gauge 111 being one of them). Directional information is computed from these gauges using a iterative maximum likelihood estimator. The second is a Baylor staff gauge (625) and a pressure gauge (641), both attached to the pier. The third is a Waverider buoy (630). The data are collected, analyzed, and stored on optical disc using a Digital Equipment Corporation VAXstation 4000. Data is sampled at 2 hertz, with five contiguous 34 minute records, for a total collection period of nearly 2 hours and 51 minutes. This report reflects the data collection periods of 0100, 0700, 1300, and 1900 EST. The results are based only on the first 34 minute record. The exception is the 8 Meter Array (3111) which condenses the first four records into one statistical value.

Wave height H_{mo} is an energy-based statistic equal to four times the standard deviation of the sea surface elevations. Wave height reported from the pressure gauge has been compensated for hydrodynamic attenuation using linear wave theory. Wave period is identified from the computation of a variance (energy) spectrum with 60 degrees of freedom calculated from a 34-min record. Peak wave period T_p is defined as the period associated with the maximum energy in the spectrum.

Table 4 presents the wave heights and periods for each wave record obtained at 6 hr intervals during the month. The monthly means and standard deviations from the means shown in Table 4 are average values computed from this data. Figure 5 is a time history of all H_{mo} and T_p values obtained for all gauges.

Differences in wave periods between wave gauges (Table 4 and Figure 5) may be the result of wave breaking, wave reformation, the presence of multiple wave trains containing nearly equal energy, and statistical variations in spectral estimations.

Table 4
Wave Data

Jan 1996											
Day	Hour	641 Pressure Gauge		625 Baylor Gauge		3111 8 Meter Array			630 Waverider		
		Hmo,m	Tp,sec	Hmo,m	Tp,sec	Hmo,m	Tp,sec	Dir,TN	Hmo,m	Tp,sec	
1	0100	0.50	7.4	0.62	7.4	0.67	7.6	110	0.79	7.6	
	0700	0.39	8.6	0.49	8.6	0.53	13.6	80	0.63	7.2	
	1300	0.37	7.8	0.48	8.3	0.55	8.2	106	0.63	8.1	
	1900	0.65	9.5	0.79	9.2	0.89	8.9	104	0.95	8.1	
2	0100	0.74	8.3	1.01	6.3	1.17	8.2	72	1.24	8.3	
	0700	0.70	8.1	0.96	8.1	0.99	8.9	68	1.10	6.5	
	1300	0.60	7.6	0.86	8.9	0.98	8.9	68	1.04	8.1	
	1900	0.57	8.1	0.82	7.8	0.87	8.2	68	0.98	8.1	
3	0100	0.51	8.1	0.78	6.3	0.81	8.9	60	0.85	8.6	
	0700	0.50	7.4	0.67	8.3	0.72	8.2	62	0.79	8.6	
	1300	0.58	8.3	0.71	7.4	0.85	7.6	56	0.89	8.6	
	1900	0.58	8.6	0.73	8.6	0.76	8.9	58	0.96	8.3	
4	0100	0.78	5.6	1.21	5.7	1.36	5.6	24	1.66	5.5	
	0700	1.00	6.3	1.12	6.1	1.21	6.6	48	1.40	6.8	
	1300	0.60	6.8	0.93	6.5	0.96	6.6	44	1.05	6.3	
	1900	0.66	6.1	0.77	6.5	0.83	6.2	46	0.90	6.6	
5	0100	0.47	4.9	0.67	9.5	0.69	8.9	58	0.80	9.2	
	0700	0.46	9.2	0.61	9.2	0.65	9.8	54	0.63	9.5	
	1300	0.36	9.5	0.61	9.2	0.74	8.9	58	0.64	8.9	
	1900	0.57	9.9	0.84	9.2	0.84	9.8	80	0.95	9.5	
6	0100	0.52	4.6	0.88	9.2	0.91	8.9	78	0.95	5.0	
	0700	0.90	5.9	1.18	5.3	1.23	5.9	48	1.25	5.4	
	1300	0.52	6.3	1.10	6.1	1.12	7.1	52	1.18	6.0	
	1900	0.87	5.6	1.48	5.2	1.50	5.6	52	1.54	5.6	
7	0100	0.60	6.3	1.91	6.5	2.23	6.6	54	2.29	6.3	
	0700	1.07	8.1	3.08	7.6	2.89	8.2	62	3.06	7.6	
	1300	0.85	8.9	2.62	8.9	2.91	8.9	58	2.75	9.2	
	1900	1.34	9.5	2.48	9.9	2.29	9.8	60	2.41	9.9	
8	0100	0.84	10.3	1.42	10.7	1.39	10.8	68	1.62	11.2	
	0700	0.78	10.7	1.17	11.2	1.10	10.8	54	1.27	11.2	
	1300	0.65	12.2	1.06	11.7	1.14	12.0	54	1.19	11.7	
	1900	1.03	7.2	1.78	12.2	1.79	12.0	56	1.82	7.8	
9	0100	0.77	12.2	1.66	12.2	1.56	12.0	56	1.65	11.7	
	0700	0.83	11.2	1.29	11.2	1.26	12.0	56	1.34	11.7	
	1300	0.52	12.9	0.85	11.7	0.89	12.0	62	0.92	11.7	
	1900	0.43	11.7	0.75	11.7	0.70	12.0	64	0.77	11.7	
10	0100	0.34	11.2	0.57	10.7	0.66	10.8	56	0.70	10.7	
	0700	0.37	12.2	0.65	12.2	0.62	12.0	58	0.77	12.2	
	1300	0.51	12.2	0.82	11.7	0.92	12.0	80	0.86	11.2	
	1900	0.79	5.3	1.20	5.5	1.45	5.9	46	1.28	6.6	

Table 4
Wave Data (continued)

Jan 1996											
Day	Hour	641 Pressure Gauge		625 Baylor Gauge		3111 8 Meter Array			630 Waverider		
		Hmo,m	Tp,sec	Hmo,m	Tp,sec	Hmo,m	Tp,sec	Dir,TN	Hmo,m	Tp,sec	
11	0100	0.95	6.8	1.52	7.2	1.54	7.1	50	1.78	7.2	
	0700	0.81	6.5	1.18	6.6	1.23	6.6	46	1.28	7.0	
	1300	0.71	6.1	0.95	11.2	0.98	6.6	48	1.07	7.6	
	1900	0.63	6.1	0.88	6.5	0.92	12.0	64	0.85	11.2	
12	0100	0.64	11.2	1.00	11.7	1.01	10.8	58	1.02	11.7	
	0700	0.76	10.7	1.49	10.7	1.35	10.8	82	1.46	5.0	
	1300	0.93	8.9	1.52	10.7	1.41	10.8	96	1.64	9.2	
	1900	0.62	10.3	1.10	10.3	1.08	10.8	104	1.22	10.7	
13	0100	0.67	10.7	0.97	10.3	0.93	10.8	58	1.00	10.3	
	0700	0.40	9.5	0.72	9.2	0.83	10.8	62	0.89	9.9	
	1300	0.78	5.5	1.07	10.3	1.06	9.8	82	1.21	9.5	
	1900	0.59	6.1	1.01	6.1	1.02	6.2	46	1.16	6.5	
14	0100	0.49	5.9	0.69	10.3	0.74	9.8	82	0.81	6.5	
	0700	0.28	9.9	0.62	10.3	0.67	10.8	90	0.68	6.6	
	1300	0.32	10.3	0.60	11.2	0.65	10.8	58	0.66	10.7	
	1900	0.22	11.2	0.57	10.7	0.58	10.8	78	0.60	9.9	
15	0100	0.27	11.2	0.45	10.7	0.53	10.8	84	0.56	10.3	
	0700	0.23	10.7	0.45	11.7	0.50	9.8	68	0.56	10.7	
	1300	0.27	15.1	0.46	12.2	0.51	13.6	64	0.56	10.7	
	1900	0.35	3.2	0.69	11.2	0.68	13.6	68	0.71	10.7	
16	0100	0.63	5.2	1.07	5.4	1.08	5.3	48	1.15	5.7	
	0700	0.65	6.6	1.20	6.8	1.23	6.6	50	1.32	6.8	
	1300	0.75	6.5	1.33	6.5	1.33	6.6	52	1.43	6.8	
	1900	0.66	6.5	1.21	7.6	1.23	7.1	54	1.32	7.4	
17	0100	0.75	7.2	1.21	8.9	1.25	8.2	60	1.28	7.8	
	0700	0.55	8.9	0.96	8.9	0.98	8.9	60	1.08	7.4	
	1300	0.45	8.6	0.87	7.2	0.86	8.9	62	0.98	8.6	
	1900	0.35	9.5	0.65	8.1	0.77	8.9	62	0.78	8.3	
18	0100	0.40	8.9	0.72	8.1	0.82	8.9	80	0.88	9.2	
	0700	0.39	9.9	0.65	10.3	0.72	8.9	70	0.75	9.9	
	1300	0.50	6.1	0.83	6.0	0.93	6.6	84	1.07	6.3	
	1900	0.76	7.2	1.16	7.4	1.30	7.6	84	1.43	7.2	
19	0100	0.62	8.6	1.65	8.3	1.70	8.9	76	1.75	8.9	
	0700	1.15	9.5	2.12	9.5	1.93	9.8	90	1.96	9.2	
	1300	0.64	10.3	1.96	10.7	1.83	9.8	82	2.09	9.9	
	1900	0.96	9.9	1.30	9.9	1.16	10.8	104	1.49	10.3	
20	0100	0.65	5.2	1.50	9.9	1.58	5.6	32	1.61	10.3	
	0700	1.12	6.3	1.86	6.3	1.91	9.8	88	2.07	6.6	
	1300	0.62	6.0	1.53	9.5	1.60	9.8	86	1.91	9.9	
	1900	0.83	10.3	1.40	10.7	1.39	10.8	84	1.57	9.5	

Table 4
Wave Data (concluded)

Jan 1996											
Day	Hour	641 Pressure Gauge		625 Baylor Gauge		3111 8 Meter Array			630 Waverider		
		Hmo,m	Tp,sec	Hmo,m	Tp,sec	Hmo,m	Tp,sec	Dir,TN	Hmo,m	Tp,sec	
21	0100	0.58	10.7	1.18	10.7	1.20	9.8	70	1.35	10.3	
	0700	0.64	9.9	1.15	9.9	1.12	9.8	62	1.24	9.9	
	1300	0.56	9.9	1.02	9.9	1.02	9.8	82	1.21	9.5	
	1900	0.62	4.8	1.18	9.9	1.13	9.8	62	1.40	9.9	
22	0100	0.57	5.3	1.22	9.9	1.25	9.8	86	1.17	10.3	
	0700	0.82	6.1	1.55	9.9	1.51	9.8	60	1.54	9.9	
	1300	0.66	6.3	1.32	9.9	1.35	9.8	70	1.34	9.9	
	1900	0.71	9.5	1.27	9.9	1.25	10.8	72	1.36	9.9	
23	0100	0.49	10.7	1.08	10.3	1.08	9.8	64	1.21	10.3	
	0700	0.57	9.9	1.10	9.5	1.19	9.8	84	1.23	9.9	
	1300	0.51	11.2	0.99	9.2	1.04	9.8	80	1.08	9.5	
	1900	0.51	9.5	1.01	9.5	0.97	9.8	68	1.02	9.5	
24	0100	0.42	10.3	0.82	10.3	0.87	9.8	62	0.95	10.3	
	0700	0.59	9.5	0.92	9.5	0.98	9.8	82	1.13	10.3	
	1300	0.67	8.3	1.00	9.5	0.94	8.9	84	1.35	9.9	
	1900	0.50	9.9	0.73	9.9	0.82	9.8	82	0.97	10.3	
25	0100	0.43	10.3	0.76	9.5	0.74	10.8	82	0.93	10.3	
	0700	0.40	4.0	0.68	10.7	0.72	10.8	60	0.87	10.7	
	1300	0.72	4.5	1.09	4.5	1.15	5.9	36	1.22	5.1	
	1900	0.53	5.6	1.00	7.2	1.01	7.1	54	1.15	7.2	
26	0100	0.47	5.0	0.78	6.6	0.78	12.0	90	0.97	11.2	
	0700	0.34	11.2	0.73	10.7	0.72	10.8	80	0.81	11.2	
	1300	0.46	10.7	0.92	11.2	0.84	10.8	76	0.93	4.1	
	1900	0.35	4.8	0.81	4.8	0.80	9.8	78	0.93	5.5	
27	0100	0.70	6.3	1.15	6.3	1.14	6.6	90	1.22	6.1	
	0700	0.81	8.9	1.94	8.6	2.01	8.9	86	2.08	8.6	
	1300	1.13	10.3	2.40	9.9	2.06	9.8	106	2.15	9.5	
	1900	0.90	10.7	1.81	10.7	1.57	10.8	102	1.88	10.3	
28	0100	0.78	10.7	0.97	10.7	1.04	10.8	104	1.24	10.7	
	0700	0.55	4.8	0.89	10.3	0.92	9.8	100	1.07	9.9	
	1300	0.66	4.9	1.14	10.3	1.18	9.8	104	1.37	9.5	
	1900	0.58	5.0	0.98	9.9	1.03	9.8	98	1.17	10.3	
29	0100	0.51	10.3	0.84	10.7	0.90	9.8	84	1.05	9.9	
	0700	0.52	9.9	0.78	9.9	0.88	9.8	100	0.95	9.9	
	1300	0.57	9.5	0.81	10.7	0.94	9.8	72	1.01	9.5	
	1900	0.44	10.3	0.86	10.7	0.84	10.8	80	0.91	9.5	
30	0100	0.56	5.3	0.89	9.9	0.84	10.8	62	0.89	10.3	
	0700	0.49	9.9	0.82	9.5	0.74	9.8	54	0.87	10.7	
	1300	0.39	6.8	0.65	9.2	0.69	9.8	84	0.74	10.3	
	1900	0.38	6.5	0.63	10.7	0.62	10.8	82	0.73	10.3	
31	0100	0.37	6.0	0.56	9.9	0.61	9.8	82	0.67	10.7	
	0700	0.34	9.9	0.52	10.7	0.53	12.0	78	0.57	10.7	
	1300	0.64	4.5	1.06	4.1	1.36	5.0	24	1.36	4.4	
	1900	0.96	6.1	1.46	5.9	1.59	6.2	50	1.71	6.1	
Mean		0.61	8.3	1.07	9.1	1.09	9.3	69	1.19	8.9	
Std dev		0.21	2.4	0.46	2.0	0.44	1.9	18	0.45	1.9	

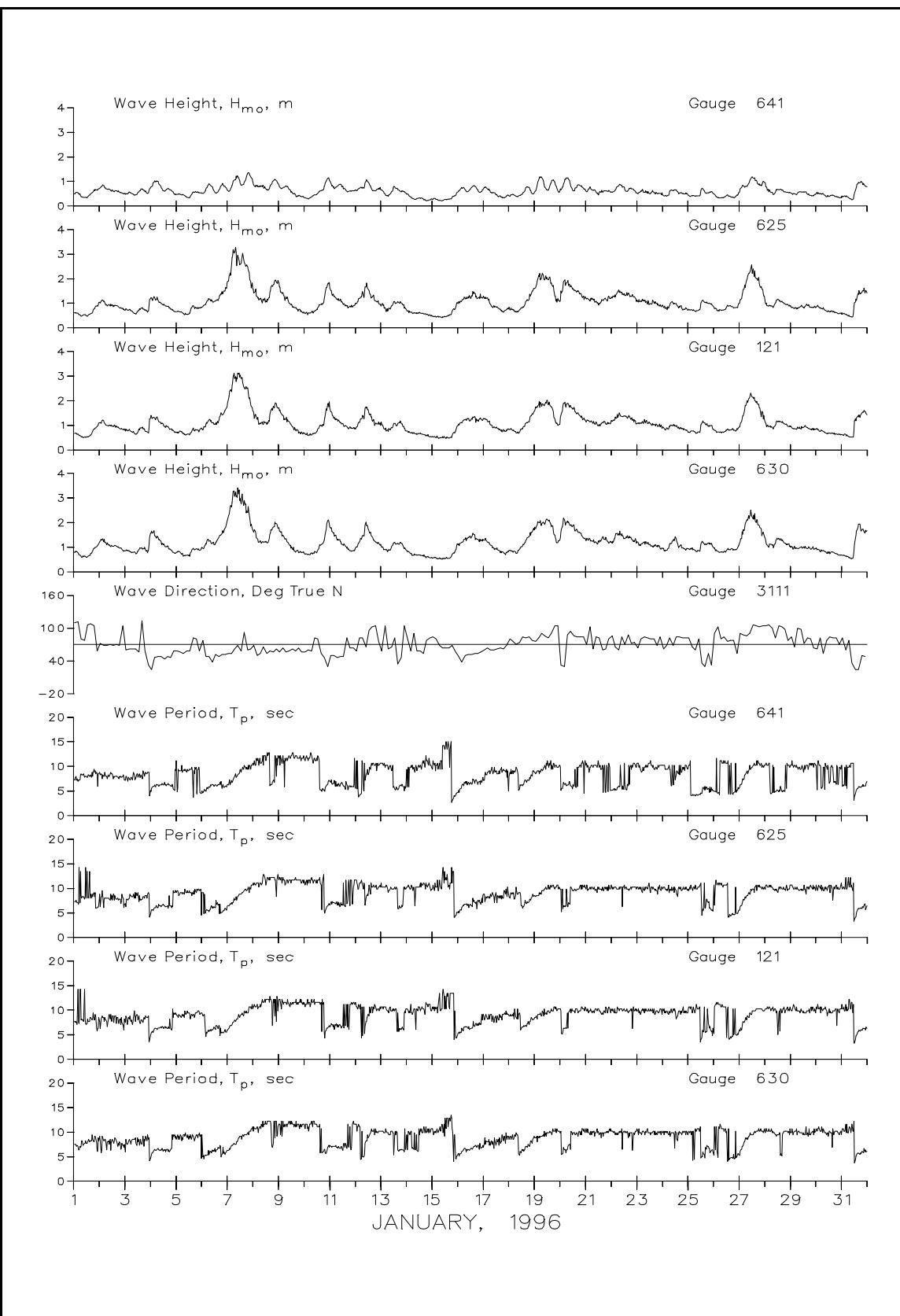


Figure 5. Wave Heights and Periods

Current Data

4

Current data (Table 5) are collected from a Marsh-McBirney electromagnetic biaxial current meter and by visually observing the movement of small drogues on the water surface in the surf and at the seaward end of the pier, as well as 500 m updrift of the pier, approximately 12 m offshore (Table 6).

Since the shoreline orientation is approximately N20W, longshore currents flow either toward 340 deg (i.e. northward) or toward 160 deg (i.e. southward). Similarly, cross-shore currents are either onshore (westward) or offshore (eastward). All current speeds are given in centimeters per second (cm/sec). Resultant speeds and directions are determined by vector averaging the cross-shore and longshore data. Current directions indicate the direction that the current is moving towards. Current data are plotted in Figure 2.

Table 5
Current Meter Data - Gauge 3539

JANUARY 1996																	
		Cross	Long			Cross	Long			Cross	Long						
Day	Time	Shore	Shore	Speed	Dir	Shore	Shore	Speed	Dir	Shore	Shore	Speed	Dir	Shore	Shore		
1	100	0	0	0		1300	-1	20	20	155	22	100	0	34	34	159	
	700	0	3	3	165	1900	0	10	10	158		700	-2	26	27	154	
	1300	1	10	10	166	12	100	1	13	13	165	1300	0	28	28	158	
	1900	1	18	18	164	700						1900	5	8	9	192	
2	100	1	14	14	164	1300						23	100	0	24	24	159
	700	5	19	20	173	1900							700	0	7	7	159
	1300	2	16	17	168	13	100	inoperative				1300	2	8	8	171	
	1900	1	14	14	164	700						1900	-2	0	3	68	
3	100	4	1	5	232	1300						24	100	0	4	4	158
	700	3	10	11	176	1900	0	6	6	155		700	3	-9	11	322	
	1300	4	0	4	271	14	100	2	-3	4	320	1300	8	-10	13	304	
	1900	3	4	5	190	700	-1	-5	6	357		1900	4	-15	17	326	
4	100	1	24	24	163	1300	0	-3	4	354	25	100	1	2	2	182	
	700	1	16	16	165	1900	-2	-2	4	16		700	2	8	8	173	
	1300	1	17	17	163	15	100	3	-3	4	303	1300	0	11	11	156	
	1900	1	12	12	164	700	1	-6	7	330		1900	0	5	5	154	
5	100	1	7	7	165	1300	-3	-7	9	7	26	100	-1	4	4	138	
	700	0	1	1	126	1900	0	6	6	148		700	2	-1	3	288	
	1300	1	3	3	179	16	100	-3	7	8	132	1300	-2	7	7	135	
	1900	0	21	21	160	700	-2	18	19	150		1900	3	5	6	186	
6	100	0	16	16	158	1300	-1	32	32	156	27	100	0	17	17	157	
	700	0	16	16	156	1900	-1	28	28	157		700	7	10	12	192	
	1300	0	17	17	158	17	100	-1	16	16	153	1300	7	-15	18	316	
	1900	-1	16	16	154	700	0	12	12	161		1900	5	-8	10	310	
7	100	-2	18	19	152	1300	-1	-5	6	2	28	100	2	13	14	170	
	700	0	28	28	158	1900	0	0	0			700	1	18	18	162	
	1300	1	25	25	162	18	100	1	-7	8	330	1300	0	13	13	155	
	1900	1	21	21	163	700	0	-2	4	352		1900	0	14	14	157	
8	100	2	9	9	170	1300	1	-2	3	320	29	100	1	7	7	170	
	700	-1	1	2	100	1900	1	2	2	177		700	0	8	8	151	
	1300	4	16	17	175	19	100	4	-9	10	320	1300	1	2	2	180	
	1900	3	20	20	167	700	1	-19	20	336		1900	1	19	19	162	
9	100					1300	-2	-44	45	344	30	100	1	7	7	170	
	700					1900	5	-8	10	314		700	0	12	12	161	
	1300					20	100	0	15	15	155	1300	1	10	10	166	
	1900					700	0	26	26	158		1900	0	9	9	162	
10	100					inoperative						31	100	1	1	1	227
	700												700	1	5	5	171
	1300											21	100	0	22	22	160
	1900	0	18	18	159								1300	-5	29	30	149
11	100												1900	-2	35	35	156
	700	0	15	15	160								1900	0	35	35	
						1300	0	32	32	159							
						1900	0	35	35	158							

KEY:

+cross-shore = offshore, cm/sec
 -cross-shore = onshore, cm/sec
 +longshore = south, cm/sec
 -longshore = north, cm/sec
 Speed = Resultant speed, cm/sec
 Dir = Resultant direction, degrees true north

Table 6
Visually Observed Current Data

Jan 1996												
Day	Pier End				Mid-Surf Zone				Beach			
	Cross Shore	Long Shore	Speed	Dir	Cross Shore	Long Shore	Speed	Dir	Location	Speed	Dir	
1	0	18	18	160	0	-29	29	340	North	0		
2	6	32	33	149	0	-14	14	340	North	10	N	
3	9	12	15	123	0	-23	23	340	North	10	S	
4	18	36	40	133	37	41	55	118	North	43	S	
5	4	12	12	143	25	16	30	104	North	4	S	
6	-9	44	44	171	0	61	61	160	North	27	S	
7	0	41	41	160	0	87	87	160	North	25	S	
8	0	34	34	160	19	12	22	103	no observation			
9	25	11	27	94	18	30	36	129	North	9	S	
10	10	25	27	138	7	15	17	133	North	40	S	
11	7	44	44	151	9	61	62	151	North	34	S	
12	0	-17	17	340	15	-30	34	7	no observation			
13	10	32	33	143	12	23	26	70	North	8	S	
14	16	-18	24	22	21	14	26	104	South	8	S	
15	0	0	0		0	-14	14	340	South	3	N	
16	0	47	47	160	0	76	76	160	no observation			
17	17	17	25	115	19	-47	51	2	no observation			
18	-2	-23	24	334	-1	-24	24	337	North	46	N	
19	12	-122	123	346	-105	-87	136	290	North	61	N	
20	0	68	68	160	-61	152	164	182	no observation			
21	6	55	56	154	46	12	47	84	South	9	N	
22	0	76	76	160	-8	55	56	169	North	35	N	
23	1	2	2	70	-11	-38	40	323	no observation			
24	14	-55	57	354	15	-76	78	351	North	119		
25	0	41	41	160	0	68	68	160	South	30		
26	2	-12	12	351	10	18	21	131	South	15	N	
27	0	-122	122	340	0	-102	102	340	North	125	S	
28	5	47	47	154	19	55	59	141	South	46	N	
29	-6	8	11	250	-3	8	9	250	North	46	N	
30	0	55	55	160	3	-19	19	349	North	58	N	
31	1	20	20	157	0	-18	18	340	North	37	N	

KEY:

- +cross-shore = offshore, cm/sec
- cross-shore = onshore, cm/sec
- +longshore = south, cm/sec
- longshore = north, cm/sec
- Speed = Resultant speed, cm/sec
- Dir = Resultant direction, degrees true north

Visual Observations

5

Visual wave direction measurements (Table 7) of both the primary wave train (i.e. that having the higher wave heights) and the secondary wave train (which must be clearly distinguishable as a wave train separate from the primary waves but not surface chop or capillary waves) are taken daily at the seaward end of the pier. The direction of the primary wave train just north of the seaward end of the pier is also determined using a Raytheon Marine Pathfinder radar and measuring the alignment of the wave crests at approximately the same location as the visual measurements. The pier axis (considered perpendicular to the beach at the FRF) is oriented 70 deg east of true north; consequently, wave angles greater than 70 deg indicate that the waves were coming from the south side of the pier.

The width of the surf zone (seawardmost breaker position to shoreline) is determined from the pier deck.

Measurements of surface water temperature, density, and depth of visibility are also taken daily at the seaward end of the pier. A Bucket Thermometer is lowered about 0.3 m into the water and allowed to remain for at least one minute. The temperature is then read, and a hydrometer is used to determine the density. A Secchi disc is used to determine the depth of visibility.

Table 7
Visual Observations

Jan 1996							
Day	Time	Wave Approach			Water Characteristics		
		Angle at Pier End deg from True N	Radar Wave Angle deg	Width of Surf Zone,m	at Pier End Density g/cc	Secchi Vis.,m	
Day	Time	Primary	Secondary	from True N	Temp.,C		
1	0935	35		27	5.6	1.0242	1.2
2	0807	80		116	5.6	1.0230	0.3
3	0810	60		35	6.1	1.0228	0.9
4	0730	45		99	6.1	1.0254	0.3
5	0755	65		43	5.6	1.0260	1.5
6	0840	50		137	5.6	1.0254	0.6
7	0830	65		279	4.4	1.0228	0.3
8	0810	65	30	76	4.4	1.0242	0.3
9	1115	65		133	4.4	1.0252	0.3
10	0800	65	25	29	3.9	1.0256	0.6
11	0810	60	30	171	2.5	1.0250	0.6
12	0820	100	20	130	2.5	1.0240	1.8
13	0910	65	30	53	1.9	1.0240	1.5
14	0855	40	70	33	4.4	1.0240	1.8
15	1135	90		30	5.0	1.0260	0.3
16	0911	25	70	132	3.6	1.0250	1.2
17	0828	70		137	2.8	1.0210	1.5
18	0820	95		131	3.3	1.0212	1.8
19	0820	100		200	4.2	1.0250	0.9
20	0830	55		197	3.9	1.0284	0.6
21	0920	80	70	110	3.3	1.0260	0.9
22	0800	50		198	2.8	1.0225	0.9
23	0745	55		120	3.3	1.0223	0.9
24	0740	95		125	3.3	1.0236	1.5
25	0800	10		61	3.9	1.0260	0.3
26	0750	35		110	3.9	1.0254	1.5
27	0903	90		293	4.4	1.0240	0.6
28	0830	5		134	3.9	1.0260	0.6
29	0730	70		148	4.2	1.0257	1.2
30	0735	110	70	126	3.6	1.0198	1.8
31	0805	120		32	3.9	1.0100	1.8

Water Levels

6

Since 1978, the National Oceanic and Atmospheric Administration (NOAA)/National Ocean Service (NOS) has operated a primary tide station (No. 865-1370) at the seaward end of the FRF pier. A NOS acoustic tide gauge (Next Generation Water Level Measurement System, NGWLMS) is used to collect water level data every 6 minutes throughout the month.

The variation in water level during the month is shown in Figure 6 along with a list of means and extreme values. This presentation is useful in identifying effects of both meteorological and astronomical forces on the open coast water level. Table 8 contains the range, high, low, and mean water level for each 12.42-hr tidal cycle.

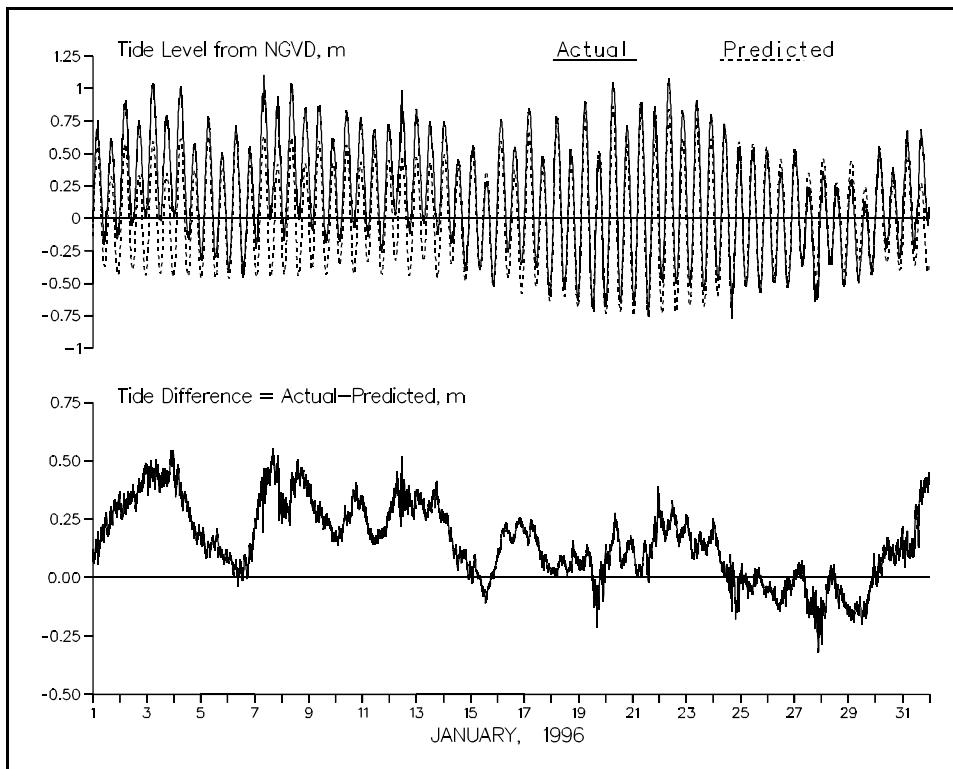


Figure 6. Water Level Variation

Table 8
Water Levels, m NGVD

JAN 1996 Tide Levels																		
Day	High			Low			Mean	Range	High			Low			Mean	Range		
	Time	m	Day	Time	m	Day			Time	m	Day	Time	m	Day				
1	0412	0.75	1	0000	-0.03	0.43	0.78	16	1512	0.55	16	0936	-0.26	0.16	0.82			
1	1612	0.61	1	1006	-0.21	0.21	0.82	17	0406	0.85	16	2112	-0.36	0.25	1.21			
2	0500	0.91	1	2142	-0.16	0.37	1.07	17	1612	0.48	17	1042	-0.38	0.07	0.86			
2	1718	0.75	2	1100	-0.06	0.33	0.81	18	0430	0.79	17	2224	-0.60	0.09	1.38			
3	0512	1.04	2	2242	0.01	0.51	1.03	18	1700	0.53	18	1118	-0.54	0.00	1.07			
3	1742	0.80	3	1254	-0.02	0.39	0.82	19	0606	0.90	18	2336	-0.63	0.13	1.53			
4	0606	1.02	4	0048	0.01	0.49	1.01	19	1900	0.50	19	1318	-0.72	-0.09	1.22			
4	1836	0.58	4	1330	-0.17	0.22	0.75	20	0654	1.05	19	2324	-0.68	0.17	1.73			
5	0636	0.78	5	0048	-0.32	0.23	1.11	20	1912	0.72	20	1342	-0.65	0.05	1.37			
5	1924	0.51	5	1248	-0.31	0.10	0.81	21	0754	0.89	21	0118	-0.64	0.13	1.53			
6	0730	0.72	6	0054	-0.40	0.14	1.12	21	1954	0.87	21	1400	-0.76	0.09	1.63			
6	1942	0.56	6	1336	-0.45	0.05	1.01	22	0812	1.08	22	0236	-0.50	0.29	1.58			
7	0818	1.10	7	0124	-0.23	0.42	1.33	22	2036	0.83	22	1436	-0.50	0.17	1.33			
7	2036	0.94	7	1348	-0.01	0.42	0.95	23	0854	0.91	23	0248	-0.51	0.20	1.42			
8	0854	1.04	8	0206	-0.17	0.42	1.21	23	2154	0.81	23	1524	-0.56	0.13	1.37			
8	2118	0.86	8	1518	-0.01	0.42	0.87	24	0942	0.73	24	0400	-0.48	0.11	1.21			
9	0936	0.87	9	0318	-0.09	0.39	0.96	24	2330	0.56	24	1624	-0.77	-0.05	1.33			
9	2148	0.62	9	1536	-0.19	0.21	0.81	25	1136	0.55	25	0530	-0.53	0.00	1.08			
10	0954	0.83	10	0354	-0.18	0.32	1.01	25	2312	0.51	25	1718	-0.57	-0.03	1.09			
10	2200	0.78	10	1606	-0.07	0.34	0.85	26	1206	0.35	26	0636	-0.50	-0.08	0.85			
11	1048	0.68	11	0436	-0.14	0.27	0.82	27	0018	0.53	26	1800	-0.54	0.00	1.07			
11	2318	0.73	11	1648	-0.26	0.24	0.99	27	1206	0.24	27	0742	-0.36	-0.06	0.60			
12	1042	0.98	12	0506	0.02	0.43	0.96	28	0136	0.37	27	1812	-0.64	-0.13	1.01			
13	0000	0.84	12	1812	-0.12	0.34	0.96	28	1242	0.26	28	0848	-0.35	-0.05	0.61			
13	1200	0.75	13	0642	-0.04	0.35	0.79	29	0312	0.30	28	2036	-0.52	-0.10	0.82			
14	0024	0.74	13	1848	-0.13	0.31	0.87	29	1442	0.13	29	0918	-0.50	-0.17	0.63			
14	1300	0.46	14	0724	-0.19	0.14	0.65	30	0324	0.55	29	2036	-0.44	0.04	0.99			
15	0218	0.56	14	1924	-0.41	0.08	0.97	30	1548	0.39	30	0936	-0.23	0.07	0.63			
15	1436	0.29	15	0824	-0.40	-0.05	0.69	31	0430	0.68	30	2106	-0.31	0.16	0.99			
16	0318	0.76	15	2030	-0.52	0.13	1.29	31	1648	0.69	31	1030	-0.25	0.21	0.94			

Bathymetry

7

A. Nearshore Profiles. In order to document profile response away from the pier, surveys of four profile lines extending 900 to 1,000 m from shore and located 489 and 581 m north and 517 and 608 m south of the FRF pier are conducted bi-weekly, after storms, and during more complete bathymetric surveys.

These profiles are obtained using the CRAB-Geodimeter surveying system; a Geodimeter 140-T self-tracking, electronic theodolite, distance meter, in combination with the Coastal Research Amphibious Buggy (CRAB), a 10.7 m high, self-powered, mobile tripod on wheels.

Figure 7 shows the last survey in December 1995 and the survey(s) in January 1996 on profile line 188, located 517 m south of the pier.

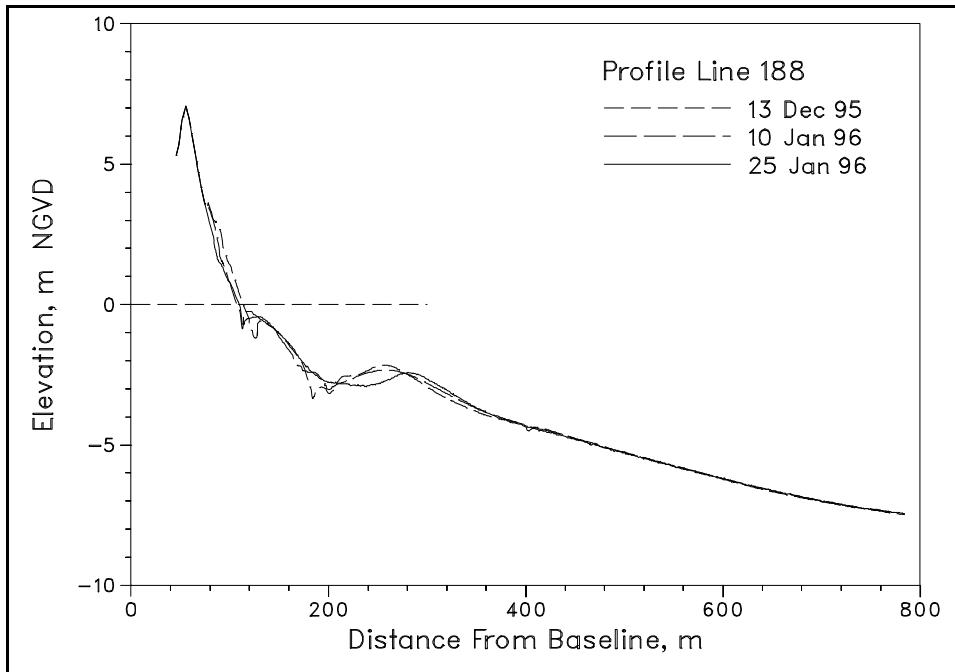


Figure 7. Monthly CRAB Profiles on Profile Line 188.

The profile envelope (Figure 8) reflects the maximum changes that occurred on the profile during 1996. Cross-hatched areas indicate changes to the annual envelope which occurred in January.

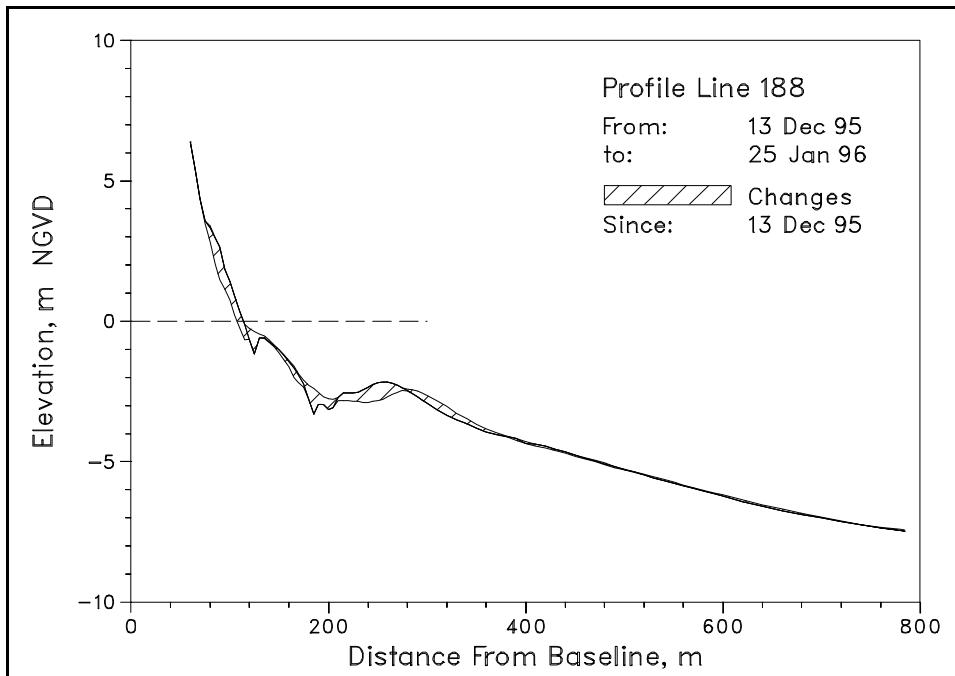
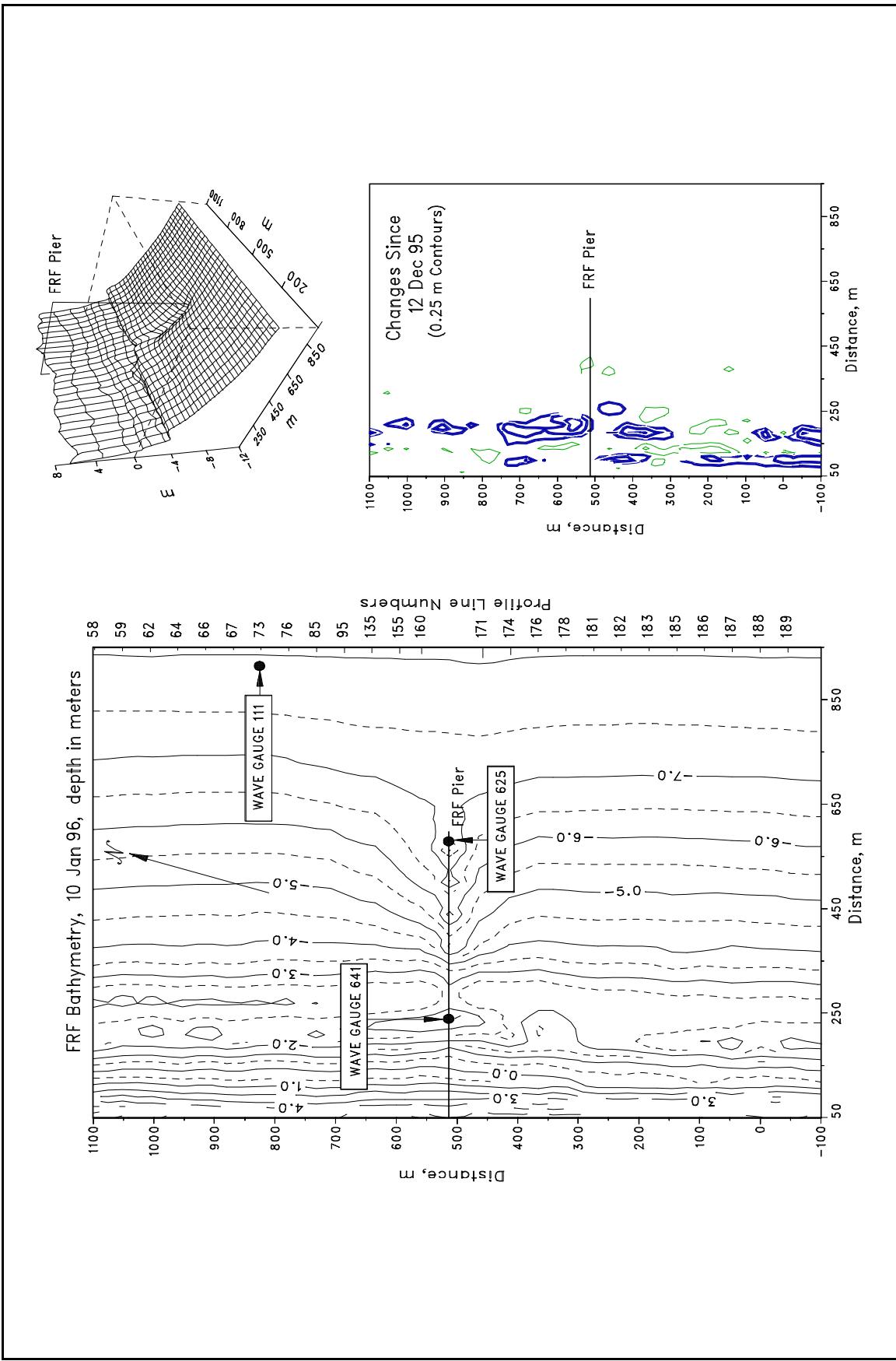


Figure 8. Profile Envelope - Profile Line 188.

B. Bathymetry. Figure 9 includes a two- and three-dimensional contour map and a change plot derived from the bathymetric survey on 10 January. Wide contour lines on the change diagram represent eroded areas; thin lines indicate deposition.



Special Events

8

A. Storm Data Collection. The following list identifies times when the wave height H_{mo} at the seaward end of the pier exceeded 2 m.

	<u>Start</u>	<u>End</u>
07 Jan (0134)	07 Jan (2116)	
19 Jan (0316)	19 Jan (1442)	
27 Jan (0734)	27 Jan (1816)	

B. Storm Synopsis.

07 Jan Northeasterly winds were funneled between a Canadian high pressure system and a low pressure system over Cape Hatteras. Maximum onshore winds (NE) reached 17 m/s at 0508 EST. The maximum H_{mo} , at gauge 630, reached 3.4 m ($T_p=8.3$ s) at 1000 EST. There was 46 mm of precipitation.

19 Jan Onshore winds associated with a cold front reached 18 m/s at 1000 EST. The maximum H_{mo} , at gauge 625, reached 2.1 m ($T_p=9.5$ s) at 0700 EST. There was 5 mm of precipitation.

27 Jan A low pressure system passed to the west of the North Carolina coast. Onshore winds (SE) reached 18 m/s at 0700 EST. The maximum H_{mo} , at gauge 625, reached 2.6 m ($T_p=9.5$ s) at 1142 EST. There was no precipitation.